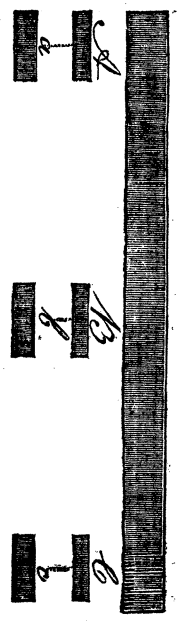
IX. *An Account of ſome Electrical Experiments, by Mr.* William Swift, *in a Letter to* John Glen King, *D. D. F. R. S.*

REV. SIR, Greenwich, Jan. 26, 1778.

Read Jan. 29. 1777. I BEG leave to lay before you an account of an electrical apparatus, which I have contrived, to ſhew the different effects of points and balls at the upper terminations of conductors, to ſecure houſes and magazines of powder from damage by lightning. I have repreſented the clouds, which are added to my machine, by interpoſing three feet of water inſulated, inſtead of continuing the metal from the prime conductor; this I apprehend to be analogous to the natural clouds, though it is not in the leaſt neceſſary for the experiments I am firſt going to mention, the reſults of which are not affected by one method more than the other.

The clouds being charged ſlide on a frame with a graduated edge; and, as they paſs the length of the frame, they make five revolutions round their own axis; for they are repreſented by a ſemi-circle, the radius of which is eighteen inches, conſequently the extent of it



is nearly four feet and a half, and is formed with materials well covered with metal. I place three houſes, ſtanding in the ſtate of nature (not connected with the cuſhion) at a certain diſtance from the frame, and equally diſtant from each other, as may be ſeen in the ſketch A, B, C, each houſe has a conductor, and is connected with magazines of powder, *a*, *b*, *c*; the reaſon for making the clouds a ſemi-circle is, that when turned back they may be charged from the machine, without affecting, or being affected by, the points or balls on the tops of the houſes A, B, and C; and, by means of their motion round their own axes, I can increaſe or diminiſh at pleaſure the velocity, which is aſcertained by the graduated edge of the frame. I fix an electrometer on one of the conductors of the machine, and put points for the upper terminations of the conductors of the houſes.

Having thus prepared the machine, the ſemi-circular cloud being turned back, that is, within; the machine is charged till the index of the electrometer riſes upwards of 90°; the cloud being then put in motion, as it ſlides along the frame, revolves over the houſe A, with its length of $4\frac{1}{2}$ feet: in its paſſage it empties itſelf, the elec-

trometer falling to o, but not the leaſt exploſion is perceived. The cloud then turning back in its progreſſive motion in the frame, is charged again while it paſſes on to B; at which point, by means of its motion round its axis, it revolves over the conductor B; it empties itſelf, the electrometer falls, and no exploſion is perceived: the ſame thing happens in the paſſage over the houſe C.

The machine remaining in the poſition as before, I place balls of a quarter of an inch diameter, at the upper terminations of the conductors of the houſes A, B, C, and with theſe balls, the experiments proceed almoſt as before; that is, the matter paſſes off with a little hiſſing noiſe, and now and then it gives a ſlight exploſion, the ſmallneſs of theſe balls differing little from points; but when I place balls of three-quarters of an inch diameter inſtead of the ſmall ones, the cloud, every time it paſſes over them, makes one or more exploſions, and fires the magazines *a*, *b*, *c*; and, notwithſtanding that, the index of the electrometer does not deſcend above 20°, and ſtarts up again as ſuddenly as it fell.

If balls are ſafer at the upper ends of conductors than points, it ſhould follow, that the larger the balls are, the greater the ſecurity; but from all theſe experiments I never found a ſhock with a point, and not always with a very ſmall ball: but the electrical matter paſſes off

ſilently with the points, and ſo entirely, that the electrometer falls to 5°. With balls a quarter of an inch diameter, indeed, it paſſes off with a little hiſſing noiſe, but this ſeldom amounts to a ſhock: but with balls three-quarters of an inch diameter an exploſion conſtantly happens, and the magazines are fired.

To put this matter ſtill more out of doubt, I place a ball of nine inches diameter on one of the conductors, and the exploſion is very violent, always more certain; and yet the machine does not diſcharge itſelf, for the electrometer falls not more than 20°.

The next experiment I make with the water conductor is, placing the houſes A, B, C, in a negative ſtate, by connecting them with the cuſhion of the machine, or with the outſide of a battery: when the cloud is charged and paſſes over the houſes, with points at the upper end of their conductors, there is no exploſion; the points ſeem to draw off all the electrical matter during the paſſage of the clouds of four feet and a half long: but when, in this poſition of the houſes, balls of three-quarters of an inch diameter are placed inſtead of points, there is a ſmall exploſion, and a conſiderable *reſiduum* of the matter is left in the battery. I then change the inſulated water for wire to compleat the circle: on the paſſage of the clouds over the houſes there is a conſi-

derable exploſion, whether points or balls are the upper terminations of the conductors of the houſes; but no *reſiduum* is left in the battery.

Hence appears the difference of effect, whether the houſes ſtand in a ſtate of nature, or in a negative ſtate; and whether the conductors be made complete with wire, or water inſulated.

I have by ſixteen years practice been convinced how difficult it is to draw general concluſions from any electrical experiments, and therefore it becomes me to propoſe my conjectures with the greateſt diffidence; but, I apprehend, the reſult of many experiments ſhew that points at the upper termination of conductors gradually diminiſh or draw off the electrical matter, ſo as to prevent any damage to the buildings on which they are placed, by preventing a violent exploſion; and that, on the contrary, balls, though perhaps they will repel the electrical matter in ſome degree, yet from that very circumſtance, probably, the exploſion, when it happens, is violent, and attended with danger.

I am, &c.